

# THE INFLUENCE OF OCEANOGRAPHIC SCENARIOS ON THE POPULATION DYNAMICS OF DEMERSAL RESOURCES IN THE WESTERN MEDITERRANEAN: HYPOTHESIS FOR HAKE AND RED SHRIMP OFF BALEARIC ISLANDS

E. Massutí<sup>1</sup>\*, S. Monserrat<sup>2</sup>, P. Oliver<sup>1</sup>, J. Moranta<sup>1</sup>, J.L. López-Jurado<sup>1</sup>, M. Marcos<sup>2</sup>, M. Hidalgo<sup>2</sup>, B. Guijarro<sup>1</sup>, A. Carbonell<sup>1</sup>

<sup>1</sup> IEO- Centre Oceanografic de les Balears, Moll de Ponent s/n, 07015 Palma de Mallorca, Spain - enric.massuti@ba.iao.es

<sup>2</sup> CSIC-UIB Institut Mediterrani d'Estudis Avançats, Miquel Marquès 21, 07190 Esporles, Spain

## Abstract

We analysed the relationships between climatic indices, population parameters (abundance, recruitment and spawning stock) and catchability of hake and red shrimp in the trawl fishery off Balearic Islands (western Mediterranean).

**Keywords :** Demersal, Recruitment, Fisheries, Hydrography, Balear Islands.

As in other areas of the western Mediterranean, the hake (*Merluccius merluccius*) and the red shrimp (*Aristeus antennatus*), two target species for the trawl fishery off Balearic Islands, exhibited inter-annual fluctuations in landings during the last decades. Within the IDEA project (www.ba.iao.es/idea) we have studied relationships between some climatic indices and parental stock, recruitment and accessibility to trawl fishery for these two species.

Available annual catch per unit effort (CPUE; as kg/HP) data series for the period 1960-2004 were used as a proxy for the abundance of these species. Their population parameters recruitment (R) and spawning stock biomass (SSB) could be obtained (for 1980-2004 for hake and for 1992-2004 for red shrimp) from assessments developed within the framework of the General Fisheries Commission for the Mediterranean. As environmental data, the meso-scale IDEA index was used [1]: higher and lower values indicate minor and major presence of WW for the Ibiza channel, the following spring respectively, which determine the spring-summer oceanographic scenarios around the Balearic Islands. Other large-scale climate indices, North Atlantic Oscillation (NAO) and Mediterranean Oscillation (MO), were also used. These indices could determine the climatic conditions where Mediterranean intermediate waters which could affect hake and red shrimp (WIW and LIW, respectively) are formed. Data series of environmental variables (NAO, MO and IDEA indices) and population dynamics parameters for hake and red shrimp (CPUE, R and SSB) used are shown in Figure 1. To analyse possible links between large- and meso-scale indices with the population dynamics of both species, two approaches have been used: (i) stock-recruitment relationships (SRR) from Ricker and Beverton-Holt models, by incorporating sequentially environment factors; (ii) generalized additive modelling, both classical general and threshold non-additive models were considered, which simulate an abrupt change in explicative variables across different phases (time periods or climatic index values). The strategy of analysis has been to consider the influence of two climatic indices for each species: the regional IDEA index and one global index (NAO for hake and MO for red shrimp). MO index values were considered with a -5 years time lag, because available information estimates that LIW requires up to 5-6 years for reaching the western basin. To avoid the influence of trends in CPUE, R and SSB, these population parameters have been conveniently detrended.

A negative significant relationship between NAO index and abundance (modelled by CPUE) and SSB of hake were found, being this effect more evident during the period 1960-1980. Results also suggest that density-dependent and environmental factors affect its R, both SSB and IDEA index improving our ability to simulate R from SRR Ricker and GAM formulations. The best model for R was obtained from the negative effect of SSB, influenced by NAO index, and IDEA index during 1980-1995. For red shrimp, a positive effect of the global MO index on its abundance and SSB was detected. Results also suggest that density-dependent and environmental factors affect R of this species. A direct positive effect of SSB and negative effect of IDEA index on R have been detected, while MO index also affects R, but indirectly through SSB.

The results indicate that macro and meso-scale climate regimes can influence the population dynamics of hake and red shrimp around the Balearic Islands. Specially for recruitment, which seems to be enhanced during low NAO and IDEA indices periods, when colder-than-normal winters, producing high generation of cold Winter Intermediate Waters in the Gulf

of Lions, which flow southwards and reach the Balearic Islands channels in spring, increasing the productivity in the area. This oceanographic scenario could also be favourable to the distribution of hake on the fishing grounds where trawl fleet target to this species, increasing its accessibility to the fishery. Both spawning stock and abundance of red shrimp seems to be also enhanced by high MO index periods, which could reflect the major presence of the saline and warm Levantine Intermediate Waters (LIW) in the study area, which extends over the fishing grounds of this species.

These proposed interactions between external and internal variables on hake and red shrimp populations can be useful to assess and manage these important demersal resources in the Balearic Islands: (i) allowing the identification of reliable environmental indices and their integration into stock assessment models; (ii) and enhancing our ability for recruitment forecasting.

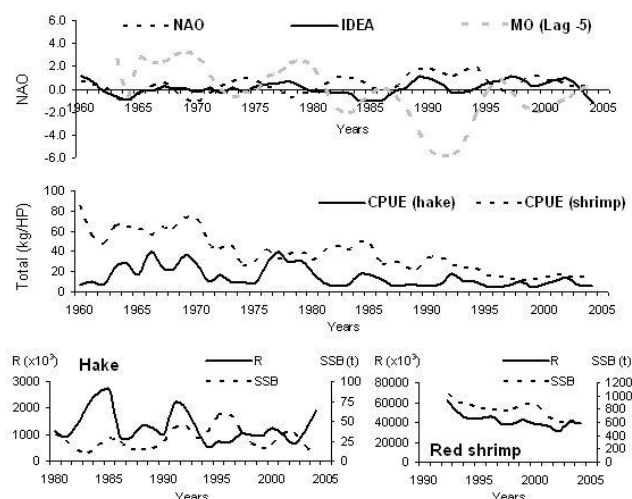


Fig. 1. Data series of environmental variables (NAO, MO and IDEA indices, represented by three years running averaged) and population dynamics (CPUE: catch per unit effort; R: recruitment; SSB: spawning stock biomass) of hake and red shrimp in the Balearic Islands used in this study.

## Acknowledgements

The IDEA project has been funded by the Spanish Ministry of Education and Science (Plan Nacional I+D+i 2000-2003, REN2002-04535-C02-02/MAR).

## Reference

Marcos M., Monserrat S., López-Jurado J.L., Massutí E., Oliver P. and Moranta J., (submitted). A mesoscale index to describe the influence of oceanographic scenarios on the population dynamics of demersal resources in the western Mediterranean: hypothesis for hake and red shrimp off Balearic Islands. *Communication to the Physics and Climate of the Oceans Committee of the 38th CIESM Congress.*